Man bites back at killer dog bites with smart optics

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Credit: AI-generated image (disclaimer)

Non-invasive diagnostics such as light scanners and swabs are increasingly used to diagnose illness in people. Now EU-backed scientists are trying to extend the techniques to the treatment of pets.

There are an estimated 90 million dogs living as pets in European

households. Having a dog in the family can make people more physically active. It can reduce feelings of isolation and loneliness. It can also improve the lives of older individuals—petting a dog has been shown to help reduce blood pressure.

But even though there is a dog living in almost 40% of European homes, there is one relatively small concern. Capnocytophaga canimorsus is a bacteria that lives in the saliva of dogs that can infect people and cause serious disease.

Although it lives in the mouths of dogs and cats harmlessly most of the time, on rare occasions, if a dog bites or licks a cut, some strains of the microbe can trigger a devastating disease in people.

Rare condition

The condition is rare, with around four cases per million inhabitants per annum. As difficult to treat as it is to pronounce, Capnocytophaga canimorsus can travel from the saliva of the dog to the blood of the person when a dog licks a scratch or an abrasion.

"The name is canimorsus, which is Latin for dog bite," said Dr. Francesco Renzi, microbiologist at the University of Namur, Belgium, "And that is clearly the main infection route."

Capnocytophaga canimorsus almost never causes illnesses in young healthy people. However, it can cause severe illness in those with compromised immune systems, those with damaged or no spleens and people suffering from alcoholism.

"People more than 60 years old are also more at risk, maybe because of their immune status," said Dr. Renzi.

The number of bacteria in the blood can spike, and cause high fever, flu-like symptoms and pain. "There are no specific symptoms, and the infection is quite rare," said Dr. Renzi. This makes it less likely for a doctor to suspect infection with these bacteria.

Septic shock

Around 30% of cases result in death, and many who survive endure amputation due to gangrene. A patient may also suffer from sepsis and multi-organ failure. While antibiotics, given early, kill the microbe, identifying Capnocytophaga canimorsus can be very difficult, even in hospital labs.

"What is important is for physicians to talk to patients and ask if they have a dog, if they have been bitten recently," said Dr. Renzi. A bite wound might not become infected, so it is not obvious that the infection entered this way.

Dr. Renzi's Belgian lab collected saliva from 285 dogs and identified Capnocytophaga canimorsus in 83% of them using a PCR test they developed for the CANITEST project.

They also established that the most harmful bacteria that causes the majority of human illnesses is present in only around 10% of dogs.

Dr. Renzi advises dog owners in the 88m European households where dogs live, to wash themselves after contact with their pet's saliva and to not allow a dog to lick an open wound or cut.

Dog diagnostics

Dr. Blaž Cugmas is a young researcher whose big passion in life is to

improve animal health. He is especially interested in how technology can be used by veterinarians to diagnose and treat pets.

After completing his Ph.D. in his native Slovenia, Dr. Cugmas moved to a lab in Riga, Latvia, which is renowned for biophotonics.

Biophotonics is a light-based method used in medicine, for example when smartphone cameras are used to analyze skin lesions for cancer.

"Most of these technologies have been developed for humans," said Dr. Cugmas, "And they cannot just be translated to animals."

The challenge was how to use biophotonics to diagnose illness in pets.

Dr. Cugmas set about developing technologies and prototypes that vets could use on animal patients as part of the dogSPEC project.

Blood sensor

Today, anyone can buy pulse oximeters, a device that shines light through a finger to a sensor on the other side. It detects blood color and thereby computes blood oxygen levels. A dramatic fall in blood oxygen, for example, can indicate serious illness.

Dr. Cugmas applied his prototype pet pulse oximeter to different locations around the body of cats and dogs to test the animals' condition.

"We showed that there are some locations where you can apply a pulse oximeter and get a strong signal," he said. This could be used by a vet to help diagnose an illness, to be validated with other tests. A speedier diagnosis will lead to better outcomes for our furry friends.

Pet thermometer

Another diagnostic device people use, but not normally pets, is an infrared thermometer. This is often used to measure body temperature of children when held close to their forehead. The devices have become widely familiar since they are used to check people's temperature in COVID-19 pandemic conditions.

Such a device for pets would be incredibly useful, said Dr. Cugmas, because normally a vet must apply a thermometer into the rectum of their patient.

"As you can imagine, this is not very popular with the animal. Cats especially don't tolerate this very well," he said. Dr. Cugmas is trying to develop a handheld IR thermometer suitable for pets. He also has a license to practice as a veterinarian.

This is a very practical challenge. Ideally, measuring temperature would be the start of a clinical examination, yet many vets avoid it, "because you will irritate the animal so much that you lose their cooperation," said Dr. Cugmas.

Skin redness

Dr. Cugmas is also developing a mobile dermatoscope for pets. This device would use light to assess the redness, or erythema, of an animal's skin. In humans, a dermatoscope is used by medical specialists to scrutinize marks that could signal melanoma skin cancer.

While dogs and cats rarely get skin cancer, skin color changes can be markers for a serious condition. For example, a dog's skin might flare up as red and itchy if they have an allergic reaction.

"We are trying to use smartphone cameras, which have a mobile dermatoscope attached, to try to measure skin erythema," said Dr. Cugmas. He demonstrated its potential in a study of 43 dogs with skin dermatitis in January 2021.

Dog-proof devices

Work is ongoing to physically strengthen devices, since some excitable dogs have in the past knocked over the prototypes and damaged them. Also, given the nature of the patient, it's important to make the devices chew-proof.

Professor Janis Spigulis is a physicist working in the same biophotonics lab in Riga. He praises the work of his colleague in transferring light-based diagnostic technology to pets. "Blaž is trying to stick to the same approaches and to make some devices that are specific for animals," he said. "Many optical technologies are unknown to veterinarians, so this interdisciplinary interaction is very positive and he has achieved good results."

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